



East Liverpool Public Meeting April 18, 2013

Health Study of Manganese (Mn) Exposure of East Liverpool, Marietta and Mt. Vernon, Ohio Adults: Preliminary Results



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As a continuation of an August 2009 manganese health study conducted in Marietta, Ohio, in November of 2011, San Francisco State University received a federal grant from the U.S. Environmental Protection Agency (U.S. EPA) to conduct a health study of adults exposed to environmental manganese in East Liverpool, Ohio. Mount Vernon, Ohio was selected as the comparison city for these studies because it is nearly identical demographically, but without the industrial activity and manganese emissions found in both Marietta and East Liverpool.

Summary:

In general, blood, neurological assessments, and neuropsychological test results of East Liverpool, Marietta and Mount Vernon residents did not differ significantly.

History and background:

In February of 2008 the Ohio EPA completed an [East Liverpool Ohio Air Quality Study](#) which indicated a health risk from exposures to airborne manganese and chromium. Ohio EPA identified the SH Bell Company, a raw products storage and packaging facility, as the source of ambient manganese and chromium sampled in community air monitors next to the Water Plant. In February 2008, the Director of the Ohio EPA petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to evaluate potential health impacts from metals measured in residential community air in East Liverpool, Columbiana County, Ohio.

In November 2010, ATSDR completed a Health Consultation for the [East Liverpool Air Quality Investigation](#), which concluded that manganese was the only chemical which exceeded both background levels and health-based guidelines. ATSDR stated that exposure to manganese concentrations in this community poses a public health hazard because the highest measured concentrations approach the low end of manganese air concentrations that have been associated with neurological impacts in occupational studies.



Study purpose, objectives and methods:

Workplace studies of occupations such as mining and welding show that excessive airborne manganese inhalation exposure can result in negative nervous system health effects. The main purpose of the health study was to evaluate whether such changes are detectable in a community with long-term, residential airborne manganese exposure.

Adults in each community between the ages of 30-75 years were randomly selected whenever possible. The data collected from the three communities include a general health questionnaire, blood test, neurological assessments, neuropsychological tests, and mood assessments. Blood was analyzed for levels of manganese (Mn), cadmium (Cd), lead (Pb) and mercury (Hg). Blood samples were also analyzed for levels of serum ferritin – an indicator of iron stored in the body. A battery of assessment tools was used to measure cognitive flexibility, information processing, working memory and attention, memory, visual tracking speed, verbal skills, motor dexterity and strength, and tremors.

In addition to blood tests, two estimates of environmental manganese exposures looked at modeled air manganese concentrations for each participant in the East Liverpool and Marietta manganese health study. We used an EPA air dispersion model (AERMOD) to estimate outdoor air concentrations of Mn at the homes of study participants. We also used a cumulative exposure index (cDEI) that calculated the AERMOD modeled air data, the distance from the Mn source, and the years of residence. The cDEI is a statistical model that provides an "exposure index" for each resident to evaluate their health outcomes.

Study Results

General Health: There were no significant differences between residents of the East Liverpool and Marietta communities in the percent of people reporting poor or fair health, the average number of poor physical or mental health days in a month, the percent of adult smokers, or the prevalence of adult obesity. There was no difference between the amounts of manganese in the diets in the three communities.

Blood: There was no significant difference between the blood manganese levels in the three communities. The average levels of manganese in blood of the general population range between 4 -15 µg/L. The average level of blood manganese levels was 10.32 µg/L in East Liverpool residents, 9.65 µg/L in Marietta residents and 9.48 µg/L in Mount Vernon residents.

East Liverpool residents had significantly higher average blood cadmium levels than Mount Vernon residents, but they were still within the normal range found in the general population. East Liverpool residents had significantly lower blood mercury levels than Marietta residents. Similarly, no significant differences were seen between all communities for blood lead and serum ferritin.

Neurological assessment:

There was no difference between the Activities of Daily Living (ADL) & motor scores in the three communities. East Liverpool residents showed slowed movement initiation compared to Mount Vernon residents. However, East Liverpool residents showed slightly better movement initiation than Marietta residents.

Neuropsychological test: Scores in all three communities were within expected "normal" ranges. No significant differences between the communities were found for test of attention, switching categories and divided attention, visual delayed memory and verbal delayed memory. East Liverpool did however have lower scores for immediate memory (daily living) than Marietta and lower scores than both Marietta and Mount Vernon for word reading, naming animals, motor speed, motor strength and motor tactile.

Mood tests: No significant differences were found between the communities on mood disturbance. However, when Marietta and East Liverpool communities are combined there were higher levels of generalized anxiety.

Conclusion:

Overall results do not demonstrate negative health effects from airborne and blood manganese in East Liverpool, Marietta and Mount Vernon residents. Few differences between the three cities were noted, and in general, all cities were within normal ranges for the overall neurological and neuropsychological tests.

What's Next?

As mentioned in the document title, these findings are preliminary. Ongoing data analysis may revise the conclusions slightly and may result in additional research.

Thank you:

We offer our sincere gratitude to all who helped develop and participated in this study. Participants will receive a personal letter and copy of their test results. Both of your communities and this effort will be recognized and you can be proud of your contributions to this community-based study and overall public health knowledge of manganese.

For questions or comments, please contact:



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